U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

ALARMS, BIOLOGICAL

1. OBJECTIVE

The objective of this materiel test procedure (MTP) is to determine the technical performance and safety aspects of the test item relative to the criteria cited in applicable Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), Technical Characteristics (TC's), and other requirements and documentation that pertain to a particular test item.

2. BACKGROUND

There is a requirement for a biological alarm capable of sensing the arrival of a biological agent cloud and activating a visual and/or audible alarm. Sensitivity and response time must be of a high order, so that personnel can receive sufficient notice to take adequate, timely protective measures. While a biological alarm is intended for field use, it must be remembered that it may well be an intricate, sophisticated piece of equipment and will function at the maximum, only if it is treated as such.

As the state-of-the-art improves, alarms with increased capabilities will be developed. The present alarms and those of the future must be subjected to a thorough testing program to establish their suitability for field operational use.

3. REQUIRED EQUIPMENT

a. Protective Clothing, as required, including:

   1) Gloves
   2) Masks
   3) Protective garments

b. Biological Test Agents, as required
c. Biological Agent Disseminators
d. Biological Sampling Equipment
e. Decontamination Equipment, as required
f. Environmental Test Chambers and Facilities, as required
g. Photographic Equipment (including color and black and white)
h. Meteorological Equipment
i. Accelerometers, as required
j. Materials Handling Equipment
k. Electromagnetic Radiation Facilities
l. Biological Laboratory Facilities
m. Nuclear Radiation Facilities
n. Vehicles (for transporting personnel and equipment)
o. Testing Sites (for appropriate testing such as air drop, etc.)
p. Communications Equipment, as required

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q. Cinetheodolite, as required
r. Sound Level Meters with Ancillary Equipment, as required
s. Octave-Band Frequency Analyzer, with required filters
t. Cathode Ray Oscilloscope, as required
u. Atmospheric Contaminants, as required
v. Blast (pressure) gages

4. REFERENCES

A. TM 3-304, Protective Clothing and Accessories.
B. MIL-STD-810B, Environmental Test Methods, 15 June 1967.
C. MIL-I-26600, Interference Control Requirements.
D. AR 705-15, Operation of Materiel Under Extreme Conditions of Environment.
E. AMC Pamphlet 706-134, Engineering Design Handbook, Maintainability Guide for Design, August 1967.
F. Final Report, Research on Rapid Detection of Aerosolized Pathogenic Micro-organisms, Melpar, Inc., February 1967.
G. Final Report, New Concepts for BW Detection, Space-General Corporation, April 1967.
H. Progress Report, Semi-specific Detection of Biological Aerosols by Fluorescent Enzymes, U. S. Navel Applied Science Laboratory, AD 804973.
I. Evaluation of Detection Devices, (Biological), Midwest Research Institute, A series of documents and test results issued in compliance with contract No. DA-18-064-430(A) for U. S. Army Biological Center.
J. Technical Status Report, Mark V Partichrome, Ft. Detrick, Md., 15 September 1967.
K. Woodson, W. E., and Conover, D. W., Human Engineering Guide to Equipment Designers, Second Edition, University of California Press, Berkeley, California, 1966.
L. MTP 8-2-500, Receipt Inspection.
M. MTP 8-2-503, Rough Handling and Surface Transport.
N. MTP 7-1-002, Air Portability and Air Drop Service Testing.
O. MTP 7-2-509, Air Drop Capability of Materiel.
P. MTP 8-2-510, Decontamination.

5. SCOPE

5.1 SUMMARY

The procedures outlined in this MTP provide general methods for determining the technical characteristics and performance of the test items. Specific testing requirements and procedures will be dictated by the performance and characteristics criteria for a particular test item.

The following subtests shall be performed on a selective basis as required to determine if the test item meets the criteria established:

a. Receipt Inspection - An inspection of the test item, as received,

to: (1) determine its physical characteristics and condition; (2) locate any defects it might have; and (3) identify damage received during transport, if necessary. During this inspection, test items will also be serialized for subsequent identification purposes.

b. Safety Evaluation - The objectives of this evaluation are (1) to check the Safety Statement issued by the developing agency; (2) to ensure that adequate safety features have been incorporated; and (3) to obtain data to be included in the Safety Release Recommendation. (Reference USATECOM Regulation 385-6).

c. Simulated Environmental Testing - A study to determine the effects of extreme temperatures, fungus, humidity, dust, solar radiation, altitude, and water (fresh water and salt water) on the test item.

d. Rough Handling and Surface Transport - A study to determine the effects of rough handling and surface transport on the physical and operational characteristics of the test item.

e. Air Transportability - A study to determine the effects of subjecting the test item to air transport conditions.

f. Air Drop Capability - A study to determine the effects on the test item resulting from its being subjected to air drop conditions.

g. Decontamination Aspects - A study to determine the relative ease or difficulty involved in decontamination of the test item and the effects of decontamination.

h. Maintenance Aspects - A study to determine the technical characteristics of the test item relative to design for maintainability provisions, aspects and instructions.

i. Operational Characteristics - A study to determine: (1) the sensitivity of the test item to prescribed agents; (2) item capability to provide the required response within the time limits prescribed; (3) sensitivity to agents or substances other than those desired; (4) whether the test item meets specified reliability criteria.

j. EMR Vulnerability - A study to determine the effects of electromagnetic radiation of various intensities, on the test item and ancillary equipment.

k. Nuclear Effects - A study to determine the effects of nuclear radiation and blast, as well as thermal effects, on the test item.

l. Human Factors - The objective of this subtest is to determine the characteristics of the test item that involve human factors considerations in the handling and operating of the test item.

5.2 LIMITATIONS

None

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Safety Statement Verification

The test officer shall verify that a Safety Statement has been received from the developing agency prior to the start of testing.

NOTE: The Safety Statement includes information pertaining to operational limitations and potential safety hazards which are peculiar to the test item.

6.1.2 Personnel Safety

a. The test plan shall ensure that tests are performed in the safest manner consistent with the accomplishment of the mission. The over riding principle shall be to limit the exposure to a minimum number of personnel, for a minimum amount of time, to a minimum amount of hazardous material, consistent with safe and efficient operations. Plans shall include safety procedures, precautions and emergency procedures, as necessary. Information based on the test item Safety Statement shall be incorporated into the test plan including: the evaluation of potential hazards; analysis of risks; limitations and special precautions. Special equipment and techniques, as required shall also be incorporated.

b. A specific individual shall be responsible for the safety aspects of each test. He must understand the operation and hazards of the test item, and the required additional equipment and facilities. He shall review test procedures for the purpose of evaluating hazards and recommend control measures.

c. All personnel who participate in or observe the test shall be informed of the hazards involved and the precautions required to ensure proper test methods and procedures.

6.1.3 Security

Security considerations shall be adequately determined and provided for as applicable to each procedure.

6.1.4 Logistical Requirements

Ensure that all logistical requirements are satisfied.

6.2 TEST CONDUCT

6.2.1 Receipt Inspection

a. Perform a receipt inspection of the test item as described by the applicable sections of MTP 8-2-500.

b. Record any damage to the test item.

c. Obtain photographs of damaged components.

d. Number and identify each test item to be used.

e. Solution containers, if present, shall be checked for leaks.

f. Determine and record the following for each test item:

1) Length
2) Width
3) Height
4) Weight

6.2.2 Safety Evaluation

Determine the test item's safety as follows:

a. Observe the operation of the test item in accordance with existing instructions, instruction manuals, directives, SOP's, and similar guidance. Record any features of the test item which might constitute a hazard to personnel.

b. Throughout the conduct of other tests, hazardous features shall be specifically observed and noted.

c. The safety aspects included in the Safety Statement prepared by the developing agency shall be verified.

d. The data to be included in the Safety Release Recommendation required by USATECOM Regulation 385-6, shall be obtained.

6.2.3 Simulated Environmental Testing

6.2.3.1 Extreme Temperature Tests

Unless otherwise directed, the test item shall be subject to the following temperature tests:

6.2.3.1.1 Low Temperature Tests - Place a minimum of 10 test items in a temperature chamber and perform the following:

a. Reduce the chamber temperature to -80°F (-62.2°C). Maintain it at -80°F for a period of 72 hours, and then visually inspect the test items and record any damages.

b. Raise the chamber temperature to -65°F (-53.9°C), or its minimum operating temperature, and maintain this temperature until stabilization is reached. If stabilization is attained in less than 24 hours, maintain temperature for a complete 24 hour interval. Perform the following:

NOTE: Stabilization, unless otherwise specified, is considered to be reached when the temperature of the test item does not change more than 3.6°F (2.°C) per hour.

1) Visually inspect the test items and record damages.
2) Verify operability of the test items as described in the procedures of paragraph 6.2.9.

NOTE: Operability checks should be accomplished within 15 minutes of removing the test items from the chamber.

c. Increase the chamber temperature to local ambient temperature and perform the following:

1) Visually inspect the test items and record damages.
2) Verify the operability of the test items as described in the procedures of paragraph 6.2.9.

6.2.3.1.2 High Temperature Tests - Place a minimum of 10 test items in a temperature chamber and perform the following:

a. Adjust the chamber to a temperature of 155°F (88.3°C) and an absolute humidity of 13 grains/ft^3, and maintain these conditions for a minimum of 4 hours, then visually inspect the test items and record any damages.

b. Adjust the chamber to a temperature of 120°F (48.9°C) and a relative humidity of no greater than 15% and maintain these conditions for a minimum of 24 hours and perform the following:

1) Visually inspect the test items and record any damages.
2) Verify the operability of the test items as described in the procedures of paragraph 6.2.9.

c. Adjust the chamber to local ambient temperature and humidity and perform the following:

1) Visually inspect the test items and record any damages.
2) Verify the operability of the test items as described in the procedures of paragraph 6.2.9.

6.2.3.2 Fungus Tests

a. Subject a minimum of 10 test items to the fungus exposure prescribed by reference 4B (MIL-STD-810), Method 508.

b. At the completion of the exposure period, perform the following:

1) Disassemble 1/2 of the items tested and record evidence of fungus on the components.
2) Verify the operability of the remaining test items using the procedures of paragraph 6.2.9.

6.2.3.3 Humidity Tests

a. Subject a minimum of 10 test items to the humidity cycling prescribed by reference 4B (MIL-STD-810), Method 507.

b. At the conclusion of humidity cycling, perform the following:

1) Inspect the test items and record any signs of corrosion.
2) Disassemble 1/2 of the items tested and inspect the components for corrosion and/or deterioration.
3) Verify the operability of the remaining test items using the procedures of paragraph 6.2.9.

6.2.3.4 Dust Tests

a. Subject a minimum of 10 test items to the dust exposure prescribed by reference 4B (MIL-STD-810), Method 510.

b. At the completion of the exposure period, perform the following:

1) Inspect the test items and record any surface wear or damage.
2) Disassemble 1/2 of the items tested and inspect the components for damage and/or the presence of dust.
3) Verify the operability of the remaining test items using the

procedures of paragraph 6.2.9.

6.2.3.5 Solar Radiation Tests

a. Subject a minimum of 10 test items to the solar radiation prescribed by reference 4B (MIL-STD-810), Method 505.

b. At the conclusion of the solar radiation cycling period, perform the following:

1) Inspect the test items and record any evidence of deterioration.
2) Disassemble 1/2 of the items tested and inspect the components for evidence of deterioration.
3) Verify the operability of the remaining test items using the procedures of paragraph 6.2.9.

6.2.3.6 Altitude Tests

a. Subject a minimum of 10 test items to the altitude conditions prescribed by reference 4B (MIL-STD-810), Method 500.

b. At the conclusion of the altitude testing, perform the following:

1) Inspect the test items and record any evidence of deterioration.
2) Disassemble 1/2 of the items tested and inspect the components for evidence of deterioration.
3) Verify the operability of the remaining test items using the procedures of paragraph 6.2.9.

6.2.3.7 Water Immersion Tests

a. Immerse a minimum of 10 test item shipping containers, without test items, in water to a predetermined depth.

NOTE: The water depth and temperature, and location of immersion shall be in accordance with applicable criteria and quality control system requirements and stipulated in the test directive.

b. Record the following with the containers immersed:

1) Depth of water over container
2) Temperature of water
3) Presence of bubbling to indicate container leakage
4) Immersion time until bubbling occurs
5) Total immersion time

c. At the completion of the immersion test, visually inspect the containers for, and record, the following:

1) Evidence of water penetration
2) Presence of corrosion

6.2.3.8 Rain Tests

a. Subject a minimum of 10 test items to the rain conditions prescribed by reference 4B (MIL-STD-810), Method 506.

b. At the conclusion of the rain tests, perform the following:

1) Inspect the test items and record any evidence of corrosion.
2) Disassemble 1/2 of the items tested and inspect the components for corrosion and water penetration.
3) Verify the operability of the remaining test items using the procedures of paragraph 6.2.9.

6.2.3.9 Salt Fog Tests

a. Subject a minimum of 10 test item shipping containers, without test items, to the conditions of reference 4B (MIL-STD-810), Method 509.

b. At the conclusion of salt fog tests, visually inspect the containers and record the following:

1) Evidence of water penetration
2) Presence of corrosion

NOTE: Containers shall be rinsed with fresh water prior to inspection.

6.2.4 Rough Handling and Surface Transport Tests

6.2.4.1 Handling and Transportation Tests

a. Subject a minimum of 10 test items, in their original package containers, to the procedures as described by the applicable sections of MTP 8-2-503.

b. At the completion of testing, perform the following:

1) Inspect the test items and record any evidence of wear and damage.
2) Disassemble 1/2 of the items tested and inspect the components for cracks, wear and damage.
3) Verify the operability of the remaining test items using the procedures of paragraph 6.2.9.

6.2.4.2 Vibration Tests

a. Conduct vibration tests on a minimum of 10 test items as described by the applicable sections of MIL-STD-810, Method 514 (for Equipment Category g, Shipment by Common Carrier).

b. At the completion of vibration testing, repeat the procedures of paragraph 6.2.4.1, step b.

6.2.4.3 Shock Tests

a. Conduct shock tests on a minimum of 10 test items as described by the applicable sections of MIL-STD-810, Method 516.

b. At the completion of shock testing, repeat the procedures of paragraph 6.2.4.1, step b.

6.2.5 Air Transportability

Determine the effects of altitude and vibration, similar to that which will be experienced by the test item in flight and in the handling during loading and unloading operations.

NOTE: Background information on air transportability is contained in MTP 7-1-002.

6.2.5.1 Loading/Unloading

a. Load the test items (in their shipping containers, if applicable) aboard aircraft or simulated aircraft as indicated in the test plan loading schedule, using normal loading equipment, and record the following:

1) Type of aircraft used/simulated
2) Shipping container dimensions
3) Shipping container weight
4) Shipping container material
5) Method of tie-down
6) Damage to package occurring during loading

b. Unload the test items from aircraft/simulated aircraft and record:

1) Equipment used in unloading
2) Difficulties encountered during unloading operations

6.2.5.2 Simulated Flight Tests

a. Subject a minimum of 10 test items (in shipping containers, if applicable) to the following simulated conditions, simultaneously:

1) Ambient pressure equal to that of the maximum altitude that the test item is expected to be flown.
2) Flight vibration conditions as described by the applicable sections of MIL-STD-810, Method 514.

b. At the completion of altitude/vibration testing, repeat the procedures of paragraph 6.2.4.1, step b.

6.2.6 Air Drop Capability

The air drop of the test item, when in its shipping containers and when assembled for field use, shall be determined as described in the applicable sections of MTP 7-2-509, and as follows:

6.2.6.1 Shipping Container Test

a. Rig a minimum of 10 test items in the appropriate air drop containers and drop the containers from aircraft flying at the altitude and speed stipulated in the test plan. Record the following:

1) Aircraft used
2) Aircraft altitude
3) Aircraft air speed
4) Meteorological conditions
5) Air delivery system trajectory and impact velocities (using a cinetheodolite)
6) Acceleration "G" force magnitude at impact

b. Photograph air drop tests with motion and still cameras.
c. At the completion of the test, perform the following:

1) Visually examine the test item's package for, and record the presence of cracks, breaks, undone bindings, etc.
2) Visually examine the test items for, and record the presence of damages and/or deformations.
4) Verify the operability of the test item by subjecting the test items to the procedures of paragraph 6.2.9.

6.2.6.2 Field Use Tests

Repeat steps a, b, and c.2 and c.3 with the test item dropped in field use condition.

6.2.7 Decontamination Aspects

a. Conduct decontamination testing of the test item as described by the applicable sections of MTP 8-2-510. Determine and record those decontamination agents and methods which provide the most satisfactory results.
b. After the decontamination, verify the operability of the test items using the procedures of paragraph 6.2.9.

6.2.8 Maintenance Aspects

a. Determine the test item maintenance aspects in accordance with AMC Pamphlet 706-134.

NOTE: The features of design which permit or enhance the accomplishment of maintenance by personnel of average skill under environmental conditions, similar to those in which maintenance is to be performed, shall be recorded.

b. Determine and record the following, as required:

1) Ease of maintenance performed
2) Component interchangeability
3) Adequacy and accuracy of the maintenance documentation
4) Maintenance category of the test item

5) Special tools and ancillary equipment required
6) Maintenance-free hours of continuous service
7) Spare parts and expendable materials required
8) Time required to perform maintenance tasks
9) Time required to detect failures
10) Time required to diagnose failures
11) Availability of go/no-go methods
12) Causes of malfunctions such as lack of operation, wear, inadequate design tolerances, poor workmanship, etc.

6.2.9 Operational Characteristics

a. Operational tests shall be performed so that the capability of the test item to meet sensitivity and response requirements and the effectiveness of its alarm system, as set forth in the applicable materiel documents, can be determined. Specific details shall be determined at the test plan stage. Tests shall be conducted concurrently, whenever possible.

b. Evaluations of the operational reliability of the test item shall be conducted based on the results of the operational tests required after the test items have been subjected to the following:

1) Simulated Environmental Testing (paragraph 6.2.3)
2) Rough Handling and Surface Transport Tests (paragraph 6.2.4)
3) Air Transportability (paragraph 6.2.5)
4) Air Drop Capability (paragraph 6.2.6)
5) EMR Vulnerability (paragraph 6.2.10)
6) Nuclear Effects (paragraph 6.2.11)

6.2.9.1 Sensitivity and Response

a. Prior to testing, the test item shall be serviced, warmed-up and a background level, suitable for the observation of challenge clouds or atmospheres, shall be obtained.

b. Determine and record the following:

1) Warm-up time
2) Background level (required instrument sensitivity calibration)

6.2.9.1.1 Laboratory Tests - Perform the following:

a. Challenge the test item with various biological agent test aerosols of pre-selected concentration levels.

NOTE: Sensitivity tests shall be conducted using as many different agents and concentration levels as are feasible or as required by the QMR's and TC's.

b. Repeat step a until each biological agent has been tested against the test item at least three times at a particular concentration level.

c. Record the following for each biological agent sample tested.

1) Biological agent identity
2) Sample concentration
3) Test item response time
4) Test number (for each concentration)
5) Mean time-between-failures
6) Mean time-between-false alarms

6.2.9.1.2 Field Tests - Perform the following:

a. Emplace the test item, as required, with respect to the wind direction, at a suitable test site.

b. Challenge the test item with various biological agents disseminated in the vicinity of the test item observing the following meteorological limitations:

1) Wind velocity of 10 mph or less
2) Temperature inversion
3) No precipitation

NOTE: 1. The biological agent challenge may be accomplished by a disseminator mounted on a moving vehicle, traveling at a prescribed speed and at a prescribed distance from the test item.
2. Personnel participating in field tests shall be adequately protected by protective clothing and equipment in accordance with safety requirements.

c. Sample and count the agent cloud particles for each agent sample, utilizing appropriate biological sampling equipment.

NOTE: 1. Examples of sampling equipment are: impingers or filters, at the site, to obtain concentrations and Reynier samplers to get cloud arrival and cloud passage time.
2. If the test item is equipped with auxiliary sampling devices, then samples shall be collected by these, concurrently.

d. Repeat steps b and c until the test item has been challenged at least three times by each biological agent disseminated.

e. Record the following for each determination:

1) Biological agent identity
2) Dissemination distance
3) Response time
4) Agent cloud particles per liter of air
5) Mean-time-between failures
6) Mean-time-between-false alarms
7) Wind velocity
8) Wind direction with respect to the test item
9) Agent cloud arrival and passage time

f. Return all samples, collected in conjunction with this testing,

to the laboratory for analysis and evaluation.

6.2.9.2 Warning Effectiveness

6.2.9.2.1 Audible Element Tests - Perform the following, as applicable:

a. Position a sound level meter at a predetermined distance and radial direction from the test item.

b. Induce an alarm condition with an agent sample and determine and record the sound power level for each mode of test item operation (i.e., alarm condition, normal operation, remote alarm, etc.)

c. Determine and record the power-frequency distribution for the various operational modes of the audible warning units.

d. Repeat steps a through c until the sound meter has been positioned at both one meter and two meters from the audible elements of the test item, at the following radial directions (with respect to the lateral center line):

1) 0°
2) 45°
3) 90°
4) 135°
5) 180°

e. Repeat steps a through d for the test item detector units operating at:

1) Lower voltage limit
2) Upper voltage limit

f. Repeat steps a through e at different various agent concentration levels for a variety of agents until at least three concentration levels for each agent have been induced.

NOTE: The audibility tests shall be conducted under "laboratory" conditions similar to those of paragraph 6.2.9.1.1.

g. Record the following for each determination:

1) Biological agent identity
2) Sample concentration level
3) Input voltage
4) Sound meter distance from the test unit
5) Sound meter radial direction from the test unit
6) Test item operating condition
7) Performance limitations resulting from the induction of the particular environment

NOTE: In addition, if, at any time during the test, a warning element is suspected of being deficient (as evidenced by a weak or distorted signal), its sound output shall be remeasured.

6.2.9.2.2 Visual Element Tests - Perform the following, as applicable:

a. Determine and record the maximum distances that a minimum of 10 test personnel can detect the test item visual warning elements under daylight conditions.

NOTE: 1. Personnel participating in visual element testing shall be adequately protected by protective clothing and equipment in accordance with safety requirements.
2. Ensure that the test subjects have normal 20/20 vision (natural or corrected) and normal color vision.
3. Field-type conditions, as described in paragraph 6.2.9.1.2, shall be used for those tests.

b. Repeat step a until at least three determinations have been made for each test personnel.
c. Repeat steps a and b under conditions of darkness.
d. Record the following for each determination:

1) Test personnel identity
2) Observation number
3) Lighting condition (daylight, darkness)
4) Biological agent used to trigger the visual alarm element

6.2.9.2.3 Detector Unit Horn Tests -

a. With the test item audible warning horn set for operation, ensure that electrical power requirements are satisfied.

NOTE: If the warning horn is battery operated from a self-contained battery pack, the batteries shall be fully charged.

b. Induce an alarm condition and allow the condition to exist until the warning horn no longer operates.
c. Repeat steps a and b until at least three determinations of detector unit horn life have been made for each possible electrical power configuration.
d. Determine and record the following for each detector unit horn test:

1) Electrical power supply configuration
2) Power requirement
3) Battery (pack) nomenclature, (if required)
4) Test number
5) Duration of horn operation
6) Cause of horn failure

6.2.9.3 Interference Aspects

The test item shall be tested to determine if false alarms will result from its exposure to particles other than the agent cloud particles present in

the ambient atmosphere. Contaminants which might reasonably be expected to be encountered in urban or military environments shall be utilized in the tests.

a. Expose the test item, in turn, in an operating mode (with background level set) to atmospheres containing:

1) Dust
2) Explosive and propellant by-products
3) Vehicular exhaust fumes
4) Fuel oil fumes
5) Decontaminants
6) Burning brush, burning wood, and burning rubber
7) Fog
8) Screening and signal smoke
9) Selected chemical agents
10) Flower or plant pollen
11) Living animals in close proximity
12) Gasoline fumes
13) Tobacco smoke
14) Other substances normally found in the ambient atmosphere, e.g., industrial plant effluents

b. Challenge the test item with single representative biological agents, at apecified concentrations, during exposure to each atmospheric contaminant as described by paragraph 6.2.9.1.1.

c. Repeat step b after each atmospheric contaminant has been removed.

d. Determine and record the following for each agent challenge:

1) Atmospheric contaminant description
2) Biological agent identity
3) Agent concentration
4) Test item response time
5) Time-between failures
6) Time-between-false alarms
7) Challenge occurrence (during contaminant exposure, after contaminant exposure)
8) Data regarding adjustments or corrective measures necessary for the test item operability

e. Record the times required for the test item to recover from each contaminant substance "poisoning".

6.2.10 EMR Vulnerability

a. Subject the test item, in an operating mode, to electromagnetic radiations of specified frequencies and intensities.

b. Challenge the test item with single representative biological agents at specified concentrations during exposure to the EMR as described by paragraph 6.2.9.1.1.

c. Repeat step b after each EMR exposure period.

d. Determine and record the following for each agent challenge:

1) EMR frequency
2) EMR intensity
3) Biological agent identity
4) Agent concentration
5) Test item response time
6) Time-between failures
7) Time-between-false alarms
8) Challenge occurrence (during EMR exposure, after EMR exposure)

e. Determine the level of EMR emanating from the test item and its effect on adjacent electronic equipment, or components.

6.2.11 Nuclear Effects

NOTE: Nuclear effects evaluation criteria for the test item shall be in accordance with those set forth in the applicable material requirements and most recently approved documents for the following:

a. Neutron dose (rads)
b. Gamma dose (rads)
c. Thermal exposure (cal/cm^2)
d. Blast level (psi) (duration in sec)

Evaluate the test item as stipulated in the detailed test plan or, as applicable, as described in the following procedures:

6.2.11.1 Neutron Radiation

a. Expose a minimum of five items to neutron radiation utilizing neutron generators, linear accelerators, or fast burst reactor (FBR) facilities, as appropriate.

NOTE: 1. The FBR is an unreflected and unmodulated critical assembly which consists of a right circular cylinder and four controlling components fabricated from uranium-molybedenum alloy.
2. When operating the unit outdoors, observe the following: The reactor shall be protected by an appropriate shield at a prescribed distance from the core center. The distance is dependent on the size of the reactor.

b. Operate the source as directed in the test plan or the units specifications to obtain the desired neutron fluence (neutrons per square centimeter).

c. Determine and record, using a counter, the delay required before the test item can be handled safely.

d. Verify the operability of the test items using the procedures of paragraph 6.2.9 when the items become safe to handle.

6.2.11.2 Blast Effects

a. Subject a minimum of 20 test items to the blast produced by a shock tube equivalent to that which would be present during a nuclear blast, as prescribed in the test plan under the following conditions:

1) One-half of the test items shall be emplaced in the open.
2) One-half of the test items shall be placed in a foxhole a minimum of two feet deep.

NOTE: These test items lying in the open shall be subject to both dynamic and static overpressures, while the items in the foxhole will be primarily affected by static overpressures.

b. At the completion of the blast period, perform the following:

1) Visually examine the test items for damages and/or deformation.
2) Verify the operability of the test items using the procedures of paragraph 6.2.9.

6.2.11.3 Thermal Radiation Test

a. Expose a minimum of 10 test items to thermal radiation for the length of time at the number of calories/cm^2 prescribed in the test item's specifications or stipulated in the test plan.

b. At the completion of the exposure period, perform the following:

1) Visually examine the test item for damage and deformation.
2) Verify the operability of the test items using the procedures of paragraph 6.2.9.

6.2.11.4 Residual Gamma Radiation

a. Expose a minimum of five test items to gamma radiation from cesium point source(s) or tube source of the type used by U. S. Army Nuclear Defense Laboratory, Edgewood Arsenal.

b. Locate the test item and a gamma dosimeter so that an eight-hour exposure is required to give the test item the prescribed total dose it would have received in a particular fallout field.

NOTE: If the test item is greater than 100 feet from the gamma source, an air attenuation factor must be considered when determining source-test item distance.

c. At the completion of eight hours exposure, record the accumulated gamma dose as measured on the gamma dosimeter.

d. Verify the operability of the test items using the procedures of paragraph 6.2.9.

6.2.12 Human Factors

NOTE: Background information on human factors engineering is available in Human Engineering Guide to Equipment Designers, Second Edition, by W. E. Woodson and D. W. Conover, University of California Press, Berkeley, California, 1966.

Data generated in the reliability test and other appropriate subtests shall be used to evaluate the test item from a human factors standpoint. At the completion of testing, the test officer shall evaluate the alarm system relative to the following:

a. Adequacy of the technical and operational literature
b. Compatibility of the test item and ancillary equipment with cold weather and CBR protective clothing
c. Contrast of warning elements to background conditions of light and noise
d. Ease of connecting and disconnecting cables and coupling devices
e. Clarity of panel lettering and markings
f. Functional labeling of switches and indicators
g. Relationships between displays and controls, as applicable
h. Ease of reading meters and dials
i. Adequacy of color coding
j. Accessibility of adjustment, calibration, and connecting devices
k. Accessibility of replaceable components
l. Simplicity, reliability, and safety of operation
m. Ease of night operations due to control shapes, dial lights, control locations, etc.
n. Portability of the test item components

6.3 TEST DATA

6.3.1 Receipt Inspection

a. Record the following for each test item:

1) Test item identification number
2) Receipt inspection data as collected under the applicable section of MTP 8-2-500
3) Test item description
4) Total number of test items inspected
5) Length, in inches
6) Width, in inches
7) Height, in inches
8) Weight, in pounds

b. Retain all photographs.

6.3.2 Safety Evaluation

Record any test item feature which constitutes a safety hazard.

6.3.3 Simulated Environmental Testing

6.3.3.1 Extreme Temperature Tests

6.3.3.1.1 Low Temperature Tests -

Record the following for each test item, as applicable:

a. Test item identification number
b. For temperature of -80°F:

    1) Damages incurred

c. For temperature of -65°F:

    1) Damages incurred
    2) Operability data collected as described in paragraph 6.2.9

d. For ambient temperature:

    1) Temperature in °F
    2) Test item damage
    3) Operability data collected as described in paragraph 6.2.9

6.3.3.1.2 High Temperature Tests -

Record the following for each test item, as applicable:

a. Test item identification number
b. For temperature of 155°F:

    1) Damages incurred

c. For temperature of 120°F:

    1) Damages incurred
    2) Operability data collected as described in paragraph 6.2.9

d. For ambient temperature:

    1) Temperature in °F
    2) Damages incurred
    3) Operability data collected as described under the applicable sections of paragraph 6.2.9
    4) Damage incurred due to testing
    5) Component damage (disassembled items only)

6.3.3.2 Fungus Tests

Record the following for each test item, as applicable:

a. Test item identification number
b. Data as collected under the applicable sections of MIL-STD-810,

Method 508

c. Evidence of fungus on:

1) Test item
2) Components (disassembled items only)

d. Operability data as collected under the applicable sections of paragraph 6.2.9

6.3.3.3 Humidity Tests

Record the following for each test item, as applicable:

a. Test item identification number
b. Data as collected under the applicable sections of MIL-STD-810, Method 507
c. Evidence of corrosion on:

1) Test item
2) Components (disassembled items only)

d. Operability data as collected under the applicable sections of paragraph 6.2.9

6.3.3.4 Dust Tests

Record the following for each test item, as applicable:

a. Test item identification number
b. Data as collected under the applicable sections of MIL-STD-810, Method 510
c. Wear and damage to:

1) Test item
2) Components (disassembled items only)

d. Evidence of dust on components
e. Operability data collected under the applicable sections of paragraph 6.2.9

6.3.3.5 Solar Radiation Tests

Record the following for each test item, as applicable:

a. Test item identification number
b. Data as collected uneer the applicable sections of MIL-STD-810, Method 505
c. Evidence of deterioration of:

1) Test item
2) Components (disassembled items only)

d. Operability data as collected under the applicable sections of paragraph 6.2.9

6.3.3.6 Altitude Tests

Record the following for each test item, as applicable:

a. Test item identification number
b. Data as collected under the applicable sections of MIL-STD-810, Method 500
c. Evidence of deterioration of:

1) Test item
2) Components (disassembled items only)

d. Operability data as collected under the applicable sections of paragraph 6.2.9

6.3.3.7 Water Immersion Tests

Record the following for each test item shipping container:

a. Container identification number
b. During immersion:

1) Depth of water over container, in inches
2) Water temperature, in °F
3) Presence of bubbling, if any
4) Immersion time to bubbling, if any, in minutes
5) Total immersion time, in minutes

c. After immersion:

1) Presence of corrosion
2) Presence of water penetration

6.3.3.8 Rain Tests

Record the following for each test item, as applicable:

a. Test item identification number
b. Data as collected under the applicable sections of MIL-STD-810, Method 506
c. Evidence of corrosion and moisture on:

1) Test item
2) Components (disassembled items only)

d. Operability data as collected under the applicable sections of paragraph 6.2.9

6.3.3.9 Salt Fog Tests

Record the following for each test item shipping container:

a. Container identification number
b. Data as collected under the applicable sections of MIL-STD-810, Method 509
c. Evidence of corrosion
d. Evidence of water penetration

6.3.4 Rough Handling and Surface Transport Tests

6.3.4.1 Handling and Transportation Tests

Record the following for each test item, as applicable:

a. Test item identification number
b. Data as collected under the applicable sections of MTP 8-2-503
c. Evidence of wear and damage to:

1) Test item
2) Components (disassembled items only)

d. Operability data collected under applicable sections of paragraph 6.2.9

6.3.4.2 Vibration Tests

Record the following for each test item, as applicable:

a. Data as collected under the applicable sections of MIL-STD-810, Method 514
b. Data as collected under paragraph 6.2.4.1, step b.

6.3.4.3 Shock Tests

Record the following for each test item, as applicable:

a. Data as collected under the applicable sections of MIL-STD-810, Method 516.
b. Data as collected under paragraph 6.2.4.1, step b.

Air Transportability

6.3.5.1 Loading/Unloading

Record the following:

a. Type of aircraft used/simulated
b. Shipping container:

1) Length, width and height, in inches
2) Weight, in pounds
3) Material (steel, aluminum, metal/reinforced plastic, etc.)

c. Equipment used in loading
d. Method of container tie-down
e. Damage to test item incurred during loading
f. Difficulties encountered while loading
g. Equipment used in unloading
h. Difficulties encountered while unloading

6.3.5.2 Simulated Flight Test

Record the following for each test item, as applicable:

a. Test item identification number
b. Altitude simulated, in feet
c. Ambient pressure in test chamber, in inches of Hg
d. Data as collected under the applicable sections of MIL-STD-810, Method 514
e. Data as collected under paragraph 6.2.4.1, step b

6.3.6 Air Drop Capability

a. Record the following for each test item during shipping container and field use tests:

1) Condition of test item (packaged, ready-for-field use)
2) Test item identification
3) Aircraft used
4) Aircraft airspeed
5) Air conditions (calm, turbulent)
6) Air delivery system trajectory
7) Test item impact velocity, in fps
8) Acceleration force at impact, in "G's"
9) For test item package:

a) Packaging material used
b) Presence of cracks, breaks, etc.
c) Undone binding

10) For the test item:

a) Damage or deformation
b) Operability data collected as described in paragraph 6.2.9

b. Retain all motion and still pictures.

6.3.7 Decontamination Aspects

Record the following for each test item:

a. Data as collected under the applicable sections of MTP 8-2-510
b. Operability data as collected under the applicable sections of paragraph 6.2.9

6.3.8 Maintenance Aspects

a. Record the following:

1) Special tools and equipment required for maintenance
2) Special skills required to perform maintenance
3) Required maintenance
4) Ease of maintenance
5) Interchangeability of components
6) Adequacy and accuracy of the maintenance documentation
7) Maintenance category of the test item

b. Retain all photographs.

6.3.9 Operational Characteristics

6.3.9.1 Sensitivity and Response

Record the following for each test item:

a. Test item identification number
b. Warm-up time, in seconds
c. Background level (required instrument sensitivity calibration)

6.3.9.1.1 Laboratory Tests -

Record the following for each biological agent sample tested:

a. Biological agent identity
b. Sample concentration, in particles per liter of air
c. Test item response time, in seconds
d. Test number for each concentration
e. Mean-time-between failures, in minutes
f. Mean-time-between-false alarms, in minutes

6.3.9.1.2 Field Tests -

Record the following for each determination:

a. Wind velocity, in mph
b. Ambient temperature, in degrees F
c. Barometric pressure, in inches of Hg
d. Instrumentation used for detections and sampling (impingers, filters, Reynier Sampler, etc.)
e. Biological agent identity
f. Dissemination distance, in meters
g. Dissemination method (vehicle with spray, etc.)

h. Dissemination vehicle speed, in mph (as applicable)
i. Sample cloud arrival time, in hours (time of day)
j. Sample cloud concentration, in particles per liter of air
k. Test item response time, in seconds
l. Agent cloud duration, in minutes
m. Mean-time-between failures, in minutes
n. Mean-time-between-false alarms, in minutes
o. Wind direction with respect to the test item

6.3.9.2 Warning Effectiveness

Record the test identification number of each item tested.

6.3.9.2.1 Audible Element Tests -

Record the following for each determination:

a. Mode of test item operation (alarm condition, normal operation, etc.)
b. Sound power level of alarm, in decibels
c. Power frequency distribution, in decibels per octave band
d. Sound meter location from the test item, in meters and radial direction (degrees from lateral centerline)
e. Test item input voltage
f. Biological agent identity
g. Agent sample concentration level, in particles per liter of air
h. Performance limitations resulting from the induction of a particular agent

6.3.9.2.2 Visual Element Tests -

Record the following for each test subject:

a. Test personnel identity
b. Observation number
c. Lighting condition (daylight, darkness)
d. Biological agent used to trigger the visual alarm element
e. Maximum distance that the visual alarm element can be detected, in meters

6.3.9.2.3 Detector Unit Horn Tests -

Record the following for each detector unit horn test:

a. Electrical power supply configuration (vehicle battery, electrical outlet, self-contained battery pack)
b. Electrical power requirements (voltage)
c. Battery (pack) nomenclature (if required)
d. Test number (1, 2, 3)
e. Duration of horn operation, in minutes
f. Cause of horn failure (horn unit, power supply, etc.)

6.3.9.3 Interference Aspects

Record the following for each biological agent challenge and test item:

a. Test item identification number
b. Atmospheric contaminant description
c. Biological agent identity
d. Agent concentration, in particles per liter of air
e. Test item response time, in seconds
f. Time-between failures, in minutes
g. Time-between false alarms
h. Challenge occurrence (during contaminant exposure, after contaminant exposure)
i. Data regarding adjustments or corrective measures necessary for the test item operability
j. Time required for the test item to recover from each contaminant substance "poisoning", in minutes

6.3.10 EMR Vulnerability

Record the following for each biological agent challenge and test item:

a. Test item identitication number
b. EMR frequency, in cps
c. EMR intensity, in watts per cm^2
d. Biological agent identity
e. Agent concentration, in particles per liter of air
f. Test item response time, in seconds
g. Time-between failures, in minutes
h. Time-between false alarms, in minutes
i. Challenge occurrence (during EMR exposure, after EMR exposure)
j. Intensity of EMR enamating from the test item
k. Effects of EMR from the test item on adjacent electronic equipment or components

6.3.11 Nuclear Effects

6.3.11.1 Neutron Radiation

Record the following for each test item:

a. Test item identification number
b. Test location (outdoors, indoors)
c. Distance from the source, in feet, if applicable
d. Neutron fluence, in neutrons per square centimeter
e. Delay period, in hours after exposure, before test item can be handled safety
f. Operability data collected as described in the applicable procedures of paragraph 6.2.9

6.3.11.2 Blast Effects

Record the following for each test item, as applicable:

a. Test item identification number
b. Test item position (in open, in foxhole)
c. Blast pressure, in psi
d. Pressure duration, in seconds
e. Damage and/or deformation incurred, if any
f. Operability data collected as described in the applicable procedures of paragraph 6.2.9

6.3.11.3 Thermal Radiation Test

Record the following for each test item, as applicable:

a. Test item identification number
b. Time of exposure, in minutes
c. Thermal radiation exposure level (cal/cm^2)
d. Damage and/or deformation incurred, if any
e. Operability data collected as described in the applicable procedures of paragraph 6.2.9

6.3.11.4 Residual Gamma Radiation

Record the following for each test item:

a. Test item identification number
b. Distance between the test item and source, in feet
c. Source radiation, in rads/hr
d. Accumulated test item gamma dose, in rads
e. Operability data collected as described in the applicable procedures of paragraph 6.2.9

6.3.12 Human Factors

The following shall be recorded:

a. Data regarding the following, relative to human factors engineering:

1) Adequacy of the technical and operational literature
2) Compatibility of the test item and ancillary equipment with cold weather and CBR protective clothing
3) Contrast of warning elements to background conditions
4) Ease of connecting and disconnecting cables and coupling devices
5) Clarity of panel lettering and markings
6) Functional labeling of switches and indicators
7) Relationships between display and controls, as applicable
8) Ease of reading meters and dials

9) Adequacy of color coding
10) Accessibility of adjustment, calibration and connecting devices
11) Accessibility of replaceable components
12) Simplicity, reliability and safety of operation
13) Ease of night operations due to control shapes, dial lights, control locations, etc.
14) Portability of the test item components

b. Comments and data from other appropriate subtests regarding the handling and other human factors aspects of the test item.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Receipt Inspection

a. Data collected as a result of this procedure shall be presented as indicated in the applicable portions of MTP 8-2-500.

b. The description of the item, number of items tested, and conditions upon receipt shall be presented in tabular form.

c. Photographs shall be used to substantiate results.

6.4.2 Safety Evaluation

a. A Safety Release Recommendation (USATECOM Regulation 385-6) shall be forwarded to U. S. Army Test and Evaluation Command within 30 days of the beginning of the test. The Safety Release Recommendation shall contain the following information: Special safety considerations on hazards to personnel and materiel (including developmental types of equipment as well as standard components used in assemblage of items being tested).

b. Data and comments relative to safety hazards observed during any phase of testing.

c. Comments relative to suggested safety improvements.

6.4.3 Simulated Environmental Testing

a. The results of the subtests conducted shall be presented in tabular or other suitable form.

b. The results of the operational check tests performed at the conclusion of the various environmental tests shall be presented in narrative or other suitable form.

6.4.4 Rough Handling and Surface Transport

a. Rough handling and surface transport data shall be presented as prescribed in MTP 8-2-503.

b. Vibration and shock data shall be presented in tabular form to indicate test times, distances (dropped), shock levels, vibration frequencies, etc., and significant findings of the test. Include photographs of damage.

c. Present data on operation of test item after subjection to rough handling and surface transport, conditions, vibration and shock.

6.4.5 Air Transportability

a. Data shall be presented in summary form as indicated in the applicable sections of MTP 7-1-002, and other pertinent testing documentation and include the pressure-altitude cycling and vibration conditions the test item was subject to.

b. Present data regarding any significant aspects of the test item observed during conduct of air transport testing.

c. Present data on test item operation after subjection to the air transport testing.

6.4.6 Air Drop Capability

For shipping containers and field use tests:

a. The results of the subtest shall be presented as prescribed in MTP 7-2-509 and include the following:

1) Type of aircraft
2) Air speed, altitude, and meteorological conditions
3) Packaging material condition after test
4) Maximum "G" force on opening of parachute and on impact

b. Present narrative comments and data regarding ease or difficulty encountered in accomplishing air drop. Present photographs (as required) to indicate results of air drop.

c. Present data on operation and performance of the test item after air drop capability subtest.

6.4.7 Decontamination Aspects

The results of this subtest shall be presented as indicated in the applicable sections of MTP 8-2-510.

6.4.8 Maintenance Aspects

Data from this subtest shall be presented in narrative form. The report shall be supplemented by photos, drawings, or other devices to substantiate the conclusions and recommendations.

6.4.9 Operational Characteristics

Data derived from this subtest shall be presented in narrative form, supplemented by drawings, photographs, charts, tables, graphs, or any other suitable means of displaying information. The report shall clearly conclude whether the test item meets the reliability criteria established in applicable specifications. Recommendations relative to further testing and methods to overcome malfunctions shall also be included.

Comparisons of the data collected under the various operability conditions with those collected during operability tests conducted after subjecting

the item to various environmental and special conditions shall be made. These comparisons shall form the basis for the definition of the test item operational characteristics.

6.4.9.1 Sensitivity and Response

Present warm-up times and background level data with the individual subtest tabulations.

6.4.9.1.1 Laboratory Tests -

Sensitivity and response characteristics of the test item to various biological agent concentrations shall be tabulated to provide a basis for comparison of the results from other laboratory tests and field tests.

6.4.9.1.2 Field Tests -

The data shall be presented for comparison to that collected in the laboratory under "controlled" conditions. Results for various methods of dissemination of the agents shall be compared, whenever possible. Effects of wind shall also be evaluated.

6.4.9.2 Warning Effectiveness

6.4.9.2.1 Audible Element Test

a. Present tabulated data to indicate sound output and power frequency distribution.
b. Present data regarding type of sound meter, sound meter readings, etc. Indicate if requirements were met.

6.4.9.2.2 Visual Element Test

a. Present narrative and tabular data on results of daylight and nighttime tests.
b. Present data regarding other significant test information such as number of test personnel, distances of test, and meteorological conditions.

6.4.9.2.3 Detector Unit Horn Test

a. Present data regarding power requirements.
b. Present data on battery pack life under continuous use conditions, if used.
c. Present mean data showing alarm duration and cause of failure.
d. Present narrative data concerning malfunctions.

6.4.9.3 Interference Aspects

Compare the data collected with that collected under conditions where no contaminant was present to evaluate the effects of various contaminants on the test item sensitivity. False alarm data shall be tabulated for each

contaminant to further determine the susceptibility of the test item.

6.4.10 EMR Vulnerability

a. Data from this subtest shall be presented in narrative form, supplemented by other required graphical or art presentations to substantiate the conclusions.

b. Significant frequencies and operational limitations shall be included, if possible.

6.4.11 Nuclear Effects

Data obtained as a result of this subtest shall be reduced and analyzed, as required. It shall be presented in the prescribed form, using tables, graphs, pictures, and narrative comments, as applicable.

6.4.12 Human Factors

a. Data from this subtest shall be presented in tabular, narrative, or other suitable form, supplemented by photographs and graphic or art presentations, as required.

b. A summary of comments regarding shortcomings and recommended improvements shall be presented.